

Episode 38

What Type of Windows Do You Need in a Passivhaus?

The show notes: www.houseplanninghelp.com/38

Intro: Bronwyn Barry is from One Sky Homes and most people have a topic that they are really passionate about and for Bronwyn that is windows. So, that's perfect, I've got lots of questions about what types of windows you need to reach Passivhaus standard. I know it's not quite as simple as that but that's what we'll find out in this interview. Bronwyn is based in San Francisco in the US, so when I hooked up with her over Skype, I was initially quite surprised that her accent wasn't what I was expecting! So I started by asking her about her origins.

Bronwyn: Alright, well you can probably guess that I've got some colonial, residual accent and that's . . . I'm originally from South Africa but I have been here in the Bay area actually for 23 years so I've picked up a bit of a hybrid accent and I sound somewhere mid pond. I had the misfortune of hearing myself on a video recently and was quietly appalled. [Bronwyn laughs.]

Ben: Oh well this podcast is not going to help you much. [Ben laughs.] It's happening all over again!

Bronwyn: Oh well.

Ben: Tell us a little bit about how you got into this line of work.

Bronwyn: My original degree was actually in the History of Art and English Literature but my favourite section of the History of Art classes was always the architecture. So I sort of did a double take after. I worked in a publishing company in London for a short while after finishing university and I realised that really wasn't what I wanted to do for the rest of my life. So I was on my way back to South Africa to do architecture and I stopped back with the host families that had hosted me as an exchange student right after high school in my gap year and they said: "Oh well why don't you come and study architecture here?" That's really the long story to how I got to doing architecture here in the United States. I came back here and I've been here ever since.

My passions for integrating good design with comfort and performance, I sort of went down that green architecture rabbit hole pretty early in my career, looking at and exploring straw bale design right out of the gate and looking at a lot of natural building materials. I did some of the first green architecture training courses that were available here from a local organisation called Builder Green and when I attended one of their presentations, a group of us actually started a little meeting organisation called the Green Remodeler's Guild and I was on the organising committee for that and we hosted a guy by the name of Nobita Hann who had come back from living in Europe and retrofitted his bungalow here in Berkeley using the Passivhaus methodology and as soon as he started explaining that I said: "Okay, that's it. That's sort of got the full package of what I've been looking for," so I just jumped into that and have been on that track ever since.

Ben: Well, I've brought you on here to help me with windows, if that's okay, because I know that you're working on some windows yourself so you're going to be able to help me on this pretty basic stuff. I'm going to go very basic to begin with. If you want me to skip this question, just say, but what is a window? [Bronwyn laughs.]

Bronwyn: That's a good fundamental place to start from actually. [Ben laughs.] A friend of mine who's also an architect has said: "All I want from a window is I want to be able to see out of it and I want to be able to open and shut it." [Bronwyn laughs.]

Essentially, that's really what a window is. Although once you start actually digging down a little deeper, a window can be so much more. That's the thing that has kept me really intrigued by them and had me really going deep into how they get put together, how they're assembled, what materials they're used from, what shape they are, all that other fun, really nitty gritty stuff that is really important when it comes to particularly high performance building because they really are the weakest link in the chain and in the whole building envelope. So how they're built and how they're designed into the envelope is actually critical to making the full package work.

Ostensibly they're quite simple things that we want to open and shut and see through but when you get into the performance aspect they're incredibly complex pieces of equipment actually. You wouldn't really think of a window as a piece of equipment but really it is. It can be that critical to your building, the success of your building.

Ben: So what are the different elements of a window? Or has that just changed over time?

Bronwyn: Well, if you think back to early windows they were these just small, tiny little openings that originally probably didn't even have glass in. Then rich people got to have glass and if you look at the history of windows . . . I know in Ireland there was a glass tax so houses were taxed on how many windows they had.

The history of windows is pretty fascinating. There's the evolution from poured, flat glass to the whole stained glass evolution in architecture and how the Gothic cathedrals really pushed the envelope of what windows really were, those were windows being used to tell stories and tell biblical . . . They were instructive essentially but they were also used to show off because there was great competition in the Gothic era to build taller and larger windows. The whole flying buttress and structural design of those buildings was very much all about *how much glass can we get in here?* I love going to see those buildings [Bronwyn laughs] because they really do tell an interesting story about windows.

Then looking at the evolution of design of windows is also pretty fascinating. There is a building in the centre of Frankfurt that I was really gobsmacked by when I went to visit it. It's the Goethe House. It's an old museum of the house where Goethe lived and worked for a period of time in the heart of Frankfurt and on the top floor are the actual original leaded glass single pane windows and the thing I just really loved about them was, those windows actually had a channel at the base and weep holes to allow the interior condensation that would form on those single pane windows to drain out to the outside. So really that was so fascinating for me to see. [Ben laughs.] They were already back in the 1600s in Frankfurt, Germany, designing windows that would weep to the outside and not rot the sill on the inside of the window so they were looking at the building science back then and coming up with solutions.

Ben: I always that example, I don't know whether you've heard this, of the ship. I may get this wrong. It's perhaps from Norway or Sweden called The Fram . . .

Bronwyn: Yup.

Ben: . . . Which was the early version of showing how Passivhaus could work and a century later we're just about getting it!

Bronwyn: Oh I know, our building technology is a very slow moving animal and yes that is an interesting story. You know it's like this has been done for centuries but clearly not in many multiple instances and we're having to reinvent the wheel constantly and re-teach the same tricks to every new generation.

Ben: I think it's working this time. We're going to get through this time. [Ben and Bronwyn laugh.] So does a Passivhaus need different windows to a traditional built house?

Bronwyn: It doesn't necessarily have to have different windows but a critical part of it is they have to be very carefully designed and selected, and it's climate specific, orientation specific and really material specific. One of the things I really like is that you're getting more and more options and architects and builders are getting much more facile at selecting the appropriate windows for each project.

I see in Austria and Germany they have so many more options to choose from because their market is much further developed than many markets here in the US. The Passivhaus community is really pushing the envelope in terms of getting manufacturers to provide the products that we really need. The imports have been dominating the Passivhaus project market and now the local producers are finally realising, *we're losing a big opportunity here – there's a growing market*. I see the UK and the US also developing products specifically tailored to our markets because the Europeans are used to the in-swing tilt and turn hardware whereas UK and US, our markets are used to an out-swing window. So it's a very different animal and the new products that are being developed in our specific regions are actually catering to that. I'm excited about that development because there's no reason why you can't make a Passivhaus out-swing window and it's been done. It's just customisation for each local marketplace so that's a great thing.

Ben: It is quite exciting, isn't it, that these developments are moving on. I know exactly what you mean that you don't want to be importing windows all the way across from Europe to the States when you can do it perfectly well yourself and it can help the economy too.

Bronwyn: Absolutely.

Ben: It's all good news. When we're thinking about windows, I know that we've obviously got to calculate how much energy it could

potentially lose. So when do we want big windows, when do we want small windows? How does all that work?

Bronwyn: Well, it's all about the solar access and the solar balance or the energy balance really of your specific project and as the projects get bigger, you know multi family projects, taller buildings, the internal gains switch from being large internal gains on big buildings to relatively small ones on single family, detached residences.

So your windows need to function differently according to each specific project type but there's also the occasions where you don't have any solar access. I've recently done a retrofit where our windows weren't net energy producers. What I mean by that is the overall energy gain from the solar gain of the windows was actually less than the amount of energy that gets lost out of the windows, just because they are a weak insulation component in your full envelope. That was in California, which you know we've got really great solar access and a relatively mild climate but this was a project that had a whole line of redwoods across the southern border of the property completely shading the house. So we really had to choose our windows that would give us lots of natural light, which people still always want no matter where you are on the planet and wouldn't lose too much heat and maintain a relatively comfortable interior temperature.

Windows are nice and complicated and that's really what makes them intriguing to me.

Ben: How would we choose a window then? Is this down to the architect who's specifying it? Or is this a personal choice for us? What tips might you give us?

Bronwyn: Well I would always say start with ones that you actually like the look of. That's typically the first place that most architects and clients go to. The next criteria that you would use would be, are the performance numbers of the ones that you like the look of, will they be adequate? And generally the third criteria, and I've found this from lots of experience is price, but typically price is not the primary driver for window selection.

There are very expensive Passivhaus certified windows on the market and then there are some very affordable ones. Some people are very particular about what materials they will and won't tolerate in their project. There's the full range from wood to fiberglass to uPVC and some people draw the line and say: "No, no uPVC on my project." Others want the aluminium [pronounced in

the American way] or what you would say aluminium [pronounced in the British way] cladding . . .

Ben: Oh, very good.

Bronwyn: [Bronwyn laughs.] Others are quite fine with a really good wood window so it's a very personal selection criteria but typically I've found it starts with aesthetics, then it's performance and then it's price.

Ben: So when we think about solar heat gains, does any window work in the same way? They'll all have heat gains?

Bronwyn: No, they will not all have heat gains. It's very contingent on the glass you . . . Let me correct that. Actually they will theoretically have heat gains, even windows on the north side that are in shade do have the potential to have heat gains but it's an overall energy balance. So you should look at a window not only as an opportunity for heat gain but it is also a great opportunity for heat loss. The glazing selection, so what glass you choose to put in the frame is a huge influence on how much heat gain you'll get in that window because there's all sorts of films and coatings that you can have applied on the glass. There's also different gas fills you can put inside the panes. You can double pane, you can have triple pane and there's a few products on the market that have quadruple pane . . .

Ben: Is it like a razor then that they just keep on adding a new blade? [Ben and Bronwyn laugh.]

Bronwyn: It does seem to be that way, doesn't it!

Ben: But going back to the gas for a moment that is injected inside, I've heard that that only lasts for a certain amount of time, so do they guarantee the lifespan of a window?

Bronwyn: That's a really interesting, hot contentious debate and there's all sorts of people getting bent out of shape about how you lose the gas when you take them over a certain altitude. They've come up with all sorts of workarounds including these pressure release tubes.

I did read one study that looked at how much gas was remaining in I think they were 10-year old windows and there was some, a minimal amount of loss, these were argon-filled units. There was a minimal amount of gas loss but it wasn't a massive amount. Having

said that, everyone has seen double pane windows that have lost the seal and have had regular air infiltrate and have condensation on the window. It's a dead giveaway when the seal's broken. So it's really so dependent on what seals are used, what spaces are used, where the window's installed. Is it in a frame that's not very stable and wiggles around a lot? Is it in a building that's got unstable soils and the structure's causing pressure on the window? It's really complicated. So there's no easy general pack answer that I think will satisfy everyone, but I will say generally they work very well and the seals and the gas inserts on modern windows have held up pretty well.

Ben: Would it be worse to lose the gas in there or to have a leakage around the outside, say if the seal went? Or are both issues?

Bronwyn: You know, I think there could be worse things that would happen and they start right from the very beginning. The gas serves a very good function, to add additional insulation to the glazing panel but if your glazing panel already has very poor performing spaces, so if they're aluminium spaces holding the two panes apart that's already probably a worse thermal bridge kind of heat loss opportunity than no gas in the window. And if your frame is a really poorly insulated frame that's another bigger opportunity for worse heat loss. Then if the installation, how the window's installed within the wall opening, if that has all sorts of metal pans that go from the inside to the exterior and big air leaks there again is another bigger offender. So, honestly, I think worrying about whether you've still got gas in your glass is probably the lowest offender on the list.

Ben: Okay, I'll move away from that then. What about installing these windows? Is it a team effort that one person installs, the other person checks all the airtightness and makes sure . . . How do we make this so that the airtightness barrier is going to work perfectly?

Bronwyn: Sure, it is a team effort and the manufacturer can make a really high performance window but then the installer can put it in a wall in a sub optimum position and not seal it properly to the building fabric and that will really diminish its performance so having everybody in the chain of custody really contribute and do a good job is really important, particularly if you're doing a high performance or a Passivhaus building.

So I've found really that's just a function of a bit of education and then the back-up testing. One of the beauties of Passivhaus is it does require a blower door test and that really will reveal any poor

workmanship, both in the production of the window itself and then again in the installation of the window in the building fabric.

Ben: Do we need to consider shading or is that another topic altogether?

Bronwyn: Absolutely, no I think it's a great question because with this opportunity for these windows to be a really great solar gain mechanisms they essentially become the heater or the heating system for the building. If you don't control that very carefully you can actually go too far and become an over-heater for the building and the whole point of doing these buildings is to have a really high comfort level.

My childhood experience was overheating and being uncomfortable from excessive heat rather than lack of heat, which is also not great. So being able to shade the windows carefully to be able to control the solar gain is just as critical and must be thought of in conjunction with the window design and where you put them in the building envelope.

Ben: Are there a specific number of ways to do this? I'll just mention the couple that I know, so you have the overhang first of all, the eaves overhang. Then you've got the brise-soleil, is it? Are there any other things or millions of things they've got to do the shading?

Bronwyn: You know I think we do have lots of options for how to do the shading. There's really everything from the building next door can be your shading mechanism to trees obviously, an easy one, but you can't put trees up a 10-storey building.

Ben: Trees, but you'd actually have that as a plan?

Bronwyn: Absolutely, but again having said that you do have to factor in, well if you're on a slope and that's blocking the uphill neighbour's view and you know, here in The Bay area view and sight lines are hotly contended. There's lots of law suits on them, too. So pick your shading mechanism and device that actually will be a long term proposition. There's all sorts of exterior louvered blinds and then the fallback is even using the glass itself, so you can modulate the solar gain with coatings on the glass and honestly that's what they have to do for high rise buildings, just add additional solar blocking coatings on the glass itself. So that's another shading option.

Ben: Well, we're just about out of time on this but I wonder whether maybe you can reflect over this interview. Is there any gaping hole

in a question that you were dying to be asked that I haven't asked just getting an overview of windows?

Bronwyn: One of the things that I'm intrigued by is really the window frame itself. It's sort of the Cinderella of the window design process. I think architects and energy modellers get very engrossed in the glass specification but one of the things that I think gets skimmed over is the actual frame design itself. And this is something that I think the Passivhaus community has really realised is the frame can make or break the window and what the early Passivhaus window designers figured out is they have to actually insulate the frame material itself to boost the performance.

I'm always trying to emphasise, look, don't get too carried away with the glass. Glass is easy to replace. Well, it's not fully. It's relatively easy to replace. There are millions of options. Most manufacturers can provide a good selection of glass inserts but most of them only offer a few options for the frame and the frame can be very complicated and you want to really be able to pay attention to how well it's put together but also how it drains at the sill.

I'm always encouraging architects and designers to really look carefully at what happens at the bottom of the window because that really is the critical piece. It should be very carefully designed and considered to make sure that's going to be a durable and high performing component. So that would be my one thing. Always look at the sill part of the frame of the window that you're going to specify and make sure that it's very resilient and has an opportunity for any moisture to get out.

Ben: Well Bronwyn, thank you very much for chatting to me about windows today. I love seeing a bit of passion as well. I can tell you love it! [Bronwyn laughs.] So we'll link you up in the show notes and put where we can follow you on Twitter and all the rest of that so thank you very much.

Bronwyn: Fantastic, thanks so much Ben. I really enjoyed chatting with you . . . in my funny accent. [Bronwyn laughs.]